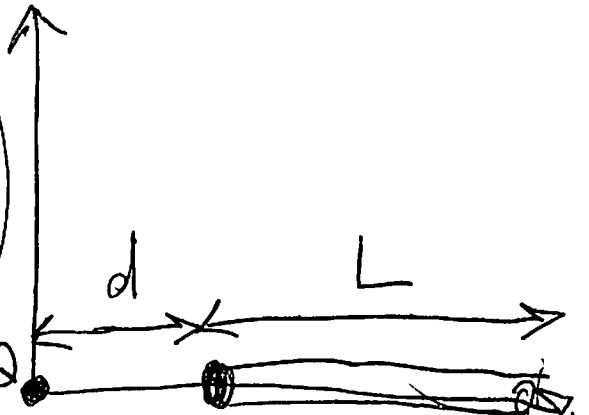
Phys 2212 Rotation Jan 19

~~Example~~ Student Problem

$\ln(e^x) = x$

$\ln(e^y) = y$

$\ln(e^x) - \ln(e^y) = x - y = \ln(e^{x-y}) = \ln\left(\frac{e^x}{e^y}\right)$



express mathematically

$d \le x \le d+L$

~~$\lambda = -\lambda_0 x$~~

$\lambda(x) = -\lambda_0 x$

$[\lambda(x)] = \frac{C}{m}$

$[\lambda_0] = \frac{C}{m^2}$, $[x] = m$, $\lambda_0 > 0$

$\vec{F} = \frac{+k\,q_1 q_2}{r^2}\hat{r}$, $dF = \frac{+kQ\,dq}{x^2}\hat{r}$

$dq = \lambda(x)\,dx$

$d\vec{F} = \hat{r}\frac{kQ\,\lambda(x)\,dx}{x^2} = \hat{r}\frac{kQ(-\lambda_0 x)\,dx}{x^2}$

$\vec{F} = \int d\vec{F} = -\int_d^{d+L} \hat{r}\frac{kQ\lambda_0 x\,dx}{x^2} = -\hat{r}kQ\lambda_0 \int_d^{d+L}\frac{dx}{x}$

$= -\hat{r}kQ\lambda_0 \ln(x)\Big|_d^{d+L} = +\hat{r}kQ\lambda_0 \ln(x)\Big|_{d+L}^{d}$

$= +\hat{r}kQ\lambda_0 \ln\left(\frac{d}{d+L}\right)$ $\quad \hat{r} = +\hat{e}_x$ $\hat{r} = -\hat{e}_x$

$$\vec{F} = +\hat{e}_x kQ\lambda_0 \ln\left(\frac{d+L}{d}\right) = +\hat{e}_x \frac{1}{4\pi\varepsilon_0} Q\lambda_0 \ln\left(\frac{d+L}{d}\right)$$